

WHAT IS CLAIMED IS:

1. A thin film magnetic head comprising:

a lower core layer;

an upper core layer; and

a recording portion that has magnetic pole layers and a gap layer positioned between the lower core layer and the upper core layer at a surface facing a recording medium,

wherein a coil insulating layer is deposited on the lower core layer and at the rear of the recording portion in a height direction;

a coil forming groove is formed in the coil insulating layer; and

a coil layer for inducing a recording magnetic field to the lower core layer, the upper core layer, and the recording portion is embedded in the coil forming groove.

2. A thin film magnetic head according to Claim 1, wherein an upper surface of the coil insulating layer and an upper surface of the coil layer are made flush with each other.

3. A thin film magnetic head according to Claim 2, wherein the upper surface of the coil insulating layer and the upper surface of the coil layer are etched surfaces.

4. A thin film magnetic head according to Claim 2, wherein, when a junction surface between the recording portion and the upper core layer is defined as a reference plane, the upper surface of the coil insulating layer and the upper surface of the coil layer are positioned to be flush with the reference plane.

5. A thin film magnetic head according to Claim 1, wherein the coil insulating layer is an inorganic insulating layer formed of an inorganic material.

6. A thin film magnetic head according to Claim 1, wherein an insulating under-layer is formed between the coil layer and the lower core layer.

7. A thin film magnetic head according to Claim 1, wherein an insulating layer is deposited on the coil layer, and a second coil layer is deposited on the insulating layer, the second coil layer being electrically connected to the coil layer and inducing a recording magnetic field to the lower core layer, the upper core layer, and the recording portion.

8. A thin film magnetic head according to Claim 1,

wherein the recording portion is constituted by a lower magnetic pole layer directly connected to the lower core layer, and a gap layer deposited on the lower magnetic pole layer, or constituted by an upper magnetic pole layer that is deposited on the lower core layer and directly connected with the upper core layer via a gap layer, or constituted by the lower magnetic pole layer directly connected with the lower core layer and an upper magnetic pole layer that is deposited on the lower magnetic pole layer via the gap layer and directly connected with the upper core layer.

9. A thin film magnetic head according to Claim 8, wherein the gap layer is composed of a nonmagnetic metal material that permits plating.

10. A thin film magnetic head according to Claim 9, wherein, for the nonmagnetic metal material, one material or two or more different materials are selected from among NiP, NiPd, NiW, NiMo, Au, Pt, Rh, Pd, Ru, and Cr.

11. A thin film magnetic head according to Claim 1, wherein the recording portion is constructed by a gap layer deposited on the lower core layer and an upper magnetic pole layer deposited on the gap layer, or the lower core layer is provided with a protuberance jutting out toward an upper

core layer integrally formed with the lower core layer, and the recording portion is constructed by a gap layer deposited on the protuberance and the upper magnetic pole layer deposited on the gap layer.

12. A thin film magnetic head according to Claim 11, wherein the gap layer is composed of an inorganic insulating material.

13. A thin film magnetic head according to Claim 12, wherein, as the inorganic insulating material, one material or two or more different materials are selected from among  $\text{Al}_2\text{O}_3$ ,  $\text{SiO}_2$ ,  $\text{SiON}$ ,  $\text{AlN}$ , and  $\text{AlSiN}$ .

14. A manufacturing method for a thin film magnetic head, comprising:

(a) a step for depositing a recording portion composed of a magnetic pole layer and a gap layer on a lower core layer;

(b) a step for depositing a coil insulating layer on a lower core layer at the rear of the recording portion in a height direction;

(c) a step for depositing a resist layer on the coil insulating layer and forming a coil pattern on the resist layer by exposure;

(d) a step for etching the coil insulating layer exposed through the coil pattern of the resist layer with a limit so that a surface of the lower core layer is not reached, thereby to form a coil forming groove in the coil insulating layer;

(e) a step for removing the resist layer;

(f) a step for embedding a conductive material in the coil forming groove formed in the coil insulating layer in the step (d), thereby to form a coil layer in the coil forming groove;

(g) a step for etching the coil layer and the coil insulating layer such that, when an upper surface of the recording portion is defined as a reference plane, an upper surface of the coil insulating layer and an upper surface of the coil layer are flush with the reference plane; and

(h) a step for depositing an insulating layer on the coil layer and the coil insulating layer, then depositing an upper core layer extending from a top of the insulating layer to an upper surface of the recording portion.

15. A manufacturing method for a thin film magnetic head according to Claim 14, comprising a step shown below between the step (b) and the step (c):

(i) a step for etching the coil insulating layer until it becomes flush with the upper surface of the recording

portion.

16. A manufacturing method for a thin film magnetic head according to Claim 14, comprising steps shown below in place of the step (a) and the step (b):

(j) a step for depositing a coil insulating layer on a lower core layer;

(k) a step for forming a groove in the coil insulating layer in the height direction from a surface facing a recording medium; and

(l) a step for forming the recording portion composed of a magnetic pole layer and a gap layer in the groove.

17. A manufacturing method for a thin film magnetic head according to Claim 14, wherein, in the step (a) or the step (l), the recording portion is composed of the lower magnetic pole layer and the gap layer, or the gap layer and the upper magnetic pole layer, or the lower magnetic pole layer, the gap layer, and the upper magnetic pole layer.

18. A manufacturing method for a thin film magnetic head according to Claim 17, wherein a nonmagnetic metal material that permits plating with the magnetic pole layer is selected for the gap layer.

19. A manufacturing method for a thin film magnetic head according to Claim 18, wherein, as the nonmagnetic metal material, one material or two or more different materials are selected from among NiP, NiPd, NiW, NiMo, Au, Pt, Rh, Pd, Ru, and Cr.

20. A manufacturing method for a thin film magnetic head according to Claim 14, wherein, in the step (a), the recording portion is formed by the gap layer and the upper magnetic pole layer, or both side surfaces of the recording portion and the surface of the lower core layer are etched after the recording portion is formed thereby to integrally form a protuberance with the lower core layer, the protuberance projecting from the top of the lower core layer toward the recording portion and continuing to the recording portion.

21. A manufacturing method for a thin film magnetic head according to Claim 20, wherein the gap layer is formed of an inorganic insulating material.

22. A manufacturing method for a thin film magnetic head according to Claim 21, wherein, as the inorganic insulating material, one material or two or more different materials are selected from among  $\text{Al}_2\text{O}_3$ ,  $\text{SiO}_2$ , SiON, AlN, and

AlSiN.

23. A manufacturing method for a thin film magnetic head according to Claim 14, wherein, to deposit the coil insulating layer on the lower core layer, an insulating under-layer is deposited on the lower core layer beforehand, and the coil forming groove is concavely formed in the coil insulating layer in the step (d) within a limit at which a surface of the insulating under-layer is exposed.

24. A manufacturing method for a thin film magnetic head according to Claim 14, wherein the coil insulating layer is formed of an inorganic insulating material.

25. A manufacturing method for a thin film magnetic head according to Claim 14, wherein, in the step (h), after the insulating layer is deposited on the coil layer and the coil insulating layer, a second coil layer to be electrically connected to the coil layer is deposited on the insulating layer, then the upper core layer is deposited on the second coil layer via the insulating layer.

26. A manufacturing method for a thin film magnetic head according to Claim 16, wherein, in the step (l), the recording portion is constructed by the lower magnetic pole



layer and the gap layer, or by the gap layer and the upper magnetic pole layer, or by the lower magnetic pole layer, the gap layer, and the upper magnetic pole layer.

27. A manufacturing method for a thin film magnetic head according to Claim 26, wherein a nonmagnetic metal material that permits plating together with the magnetic pole layers is selected for the gap layer.

28. A manufacturing method for a thin film magnetic head according to Claim 27, wherein, as the nonmagnetic metal material, one material, or two or more different materials are selected from among NiP, NiPd, NiW, NiMo, Au, Pt, Rh, Pd, Ru, and Cr.